Development of Electrolytes for Low Temperature Rechargeable Lithium Cells

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ABSTRACT

Rechargeable Li-ion batteries are an emerging new technology to be used in future NASA micro-spacecraft missions. This technology offers the advantages of light weight, high energy density, and the capability of long cycle life. Various rechargeable battery systems, such as Ni/Cd or Ni/H, have attractive specific and power densities but limited operating temperature range due to the use of aqueous-based electrolyte in most cases. In addition, the realizable efficiencies and energy densities of these systems are rather low at sub-zero temperatures. The ambient temperature of some of NASA planetary missions are much lower than -20 "C. This necessitates insulation of the battery from extreme ambient temperatures prevalent at planetary surfaces and possibly a warm up of the battery by another **energy** source. No electrochemical **systems** are known to function effectively in such cold environments. At JPL, we propose to carry out studies leading to an identification and evaluation of such a cryogenic battery system, based on our present understanding of the advanced Li and Li-ion battery systems. The limited temperature range of the existing battery systems is due to the freezing of the electrolyte solution at temperatures below -20 "C. Accordingly, the proposed study begins with a series of experiments leading to an identification of suitable electrolyte solutions based on solvents that maintain the liquid state at low temperature. The goal of the electrolyte sub-task is to identify an electrolyte with a conductivity of 10-4 to 10^{-2} S/cm in the temperature range of -40 to O °C. In this paper, we will summarize the results of our recent studies on low temperature electrolyte development.